

Remarks on "Piezonuclear neutrons from fracturing of inert solids"

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ABSTRACT

In two series of measurements, Cardone, Carpinteri *et al.* report an excess of neutrons over the background flux corresponding to the catastrophic fracture of a granite block subject to compression. Here we show that these measurements contain large inconsistencies with respect to the stated experimental procedure, including fractional neutron counts and strongly non Poissonian statistics.

1. INTRODUCTION

In Ref. 1,2 an excess of neutrons over the background flux, corresponding to the catastrophic fracture of a granite block subject to compression, is reported.

The neutron flux is measured using a single He³ detector, whose count rates (cps) are reported as graphs versus time. Counts are integrated over 60 s periods, for the duration of each measurement (approx. 35 minutes).

Another set of measurements, involving 7 granite blocks, with the same experimental set-up, is reported in Ref. 3. 5 of the 7 measurements show an excess of neutron counts during granite fracture, but only the 3 most statistically significant, labelled P6, P8 and P9, are reported in detail.

Both sets show evident anomalies, both in the reported data points and in their statistics.

2. FRACTIONAL COUNTS

The neutron flux is reported articles in graph format, in units of counts per second (cps). These values can be converted to counts per measurement period (counts per minute, or cpm), with an accuracy of better than 0.2 cpm. For comparison, the error bars shown in the graph are at ± 0.12 cpm. As counts are discrete events, the measured values should be always multiple of 1 cpm, or 1/60 cps. With a vertical scale of roughly 1.85 mm/cpm, a quantization in the vertical scale for the measurement result should be easily appreciable. On the contrary, all plots in Ref. 2 show fluctuations that are almost continuous, up to the graphical resolution of the plots. For example the background for specimen P3, after the first 5 minutes, undulate almost continuously between 1.8 and 2.7 counts per integration period.

The flux observed during the fracture of block P4 is reported as 0.272 cps, consistent with the position of the data point in the graph. This corresponds to 16.3 counts in the measurement period.

Possible explanations for fractional counts could involve a large number of detectors, but it is explicitly stated that only one He³ tube was available.

In Ref. 3 the background measurements are reported as multiples of 1.6×10^{-2} counts per second, i.e. integer counts over the 60 seconds acquisition time. But while for P6 measurements are reported every 60 s, for the shorter measurements P8 and P9 they are reported every 15 s. This is inconsistent with the experiment description, but if the acquisition time was actually shortened, the reported values would result in fractional counts. Measures do not overlap, as the excess neutron flux can be seen in just one data point.

3. STATISTICAL ANALYSIS

In Ref. 2 the background neutron flux is reported as $3.8 \pm 0.2 \times 10^{-2}$ cps. The stated uncertainty is 4 times lower than the expected standard deviation for a Poissonian distribution with 23 measured neutrons, as can be derived from the integration time of 600 s. This uncertainty is used for all measurements in the article, despite the still much lower statistics for the background and event samples, that should give statistical errors at least 12 times larger.

The scatter in the background flux is incredibly low. A Poissonian statistics with a mean of 2.3 events per period should involve a much larger scatter. In a 35 minute period, one should observe a few periods with no counts at all, and a few with 5 or more counts (7.3×10^{-2} cps), while no such occurrences are visible in the four graphs shown. The variance in the background measurements for specimen P3, for example, is around 0.25 (cpm)², 8 times less than the expected value for Poissonian events. Fluctuations are much lower, usually less than 0.2 counts, over most of the background graphs for all specimen. The time series, in all graphs, show also a very strong correlation in time, up to several minutes, not consistent with background random radioactive events.

Analysis of Ref. 3 depends on which of the assumptions on the measurement time are correct. Assuming a measurement time of 15 s would be absolutely inconsistent with a Poissonian statistics, so 60 s has been assumed. In this case measurement statistics is comparable among samples, consistent with the almost uniform background flux measured. The statistics of all the 77 background data points plotted in the three graphs has thus been carried together, as a single population. From these measures, a background flux of $4.0 \pm 0.45 \times 10^{-2}$ cps can be derived, again consistent with the background fluxes listed in their tab. 3. For subsequent analysis, a background flux of 4.2×10^{-2} cps has been assumed.

The distribution is however quite odd: it is reasonably consistent with a Poisson distribution, for both the above values of the background flux, except that there are no occurrences of measurement periods with zero detections. The expected number of such occurrences would be between 6.2 and 7, among the 77 background data points plotted in Ref. 3, with a probability of less than 0.2% of observing no such occurrences.

4. CONCLUSIONS

The data presented in the analyzed articles by Carpinteri *et al.* cannot be the result of a measurement using a counting detector. The first set of measurements shows non-integer counts in the reported measurements. The figures for samples P8 and P9 of Ref. 3 show 4 times more points than those actually measured. The measurement statistics is completely meaningless in the first set of measurements, and inconsistent with a Poisson statistics in the second.

REFERENCES

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